

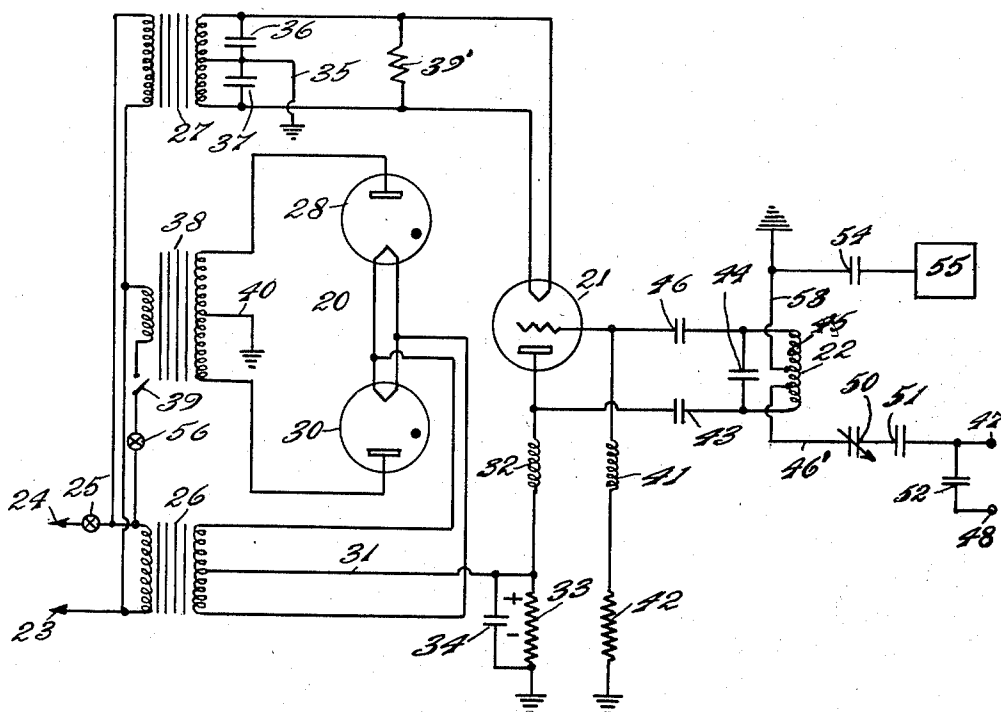
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DEVICE FOR PERFORMING SURGICAL INCISIONS BY ELECTRONIC ENERGY

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DEVICE FOR PERFORMING SURGICAL INCISIONS BY ELECTRONIC ENERGY

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1 Claim. (Cl. 128—303.14)

The present invention relates to methods of making incisions in the body in live tissue without shock and without tissue damage which will interfere with normal healing, and to apparatus for this purpose of the character generally known in the trade as an electric or electronic cautery, knife, scalpel or electrotome.

A purpose of the invention is to minimize tissue damage in making incisions, and thus produce incisions in surgery which will heal rapidly and will not cause a necrotic effect along the edge of the incision.

A further purpose is to minimize all nervous reaction of the patient which may contribute to shock.

A further purpose is to insure the introduction of a maximum of electronic energy at the point of incision in a minimum of time, and at a frequency which will be most favorable from the standpoint of rapid recovery.

A further purpose is to produce a uni-directional current from an alternating current, to convert the uni-directional current into a full wave pulsing current at a frequency between 2.75 and 3.25 megacycles per second, and to pass the high frequency current thus produced into the body of the patient at a terminal provided with an incision instrument, connecting another terminal to a dispersive contact.

A further purpose is to produce a uni-directional current by rectifying an alternating current, to produce a high frequency current of regulated frequency from the uni-directional current, to pass the high frequency current through a resonant tank circuit, to conduct current to the patient from the inductive element of the tank circuit and to employ capacitive blocking between each contact applied to the patient and the tank circuit, and also preferably between the source of high frequency current and the tank.

A further purpose is to energize the cathodes of the rectifier and transmitter tubes by a pre-action switch and to produce operation of the electronic cautery by a final action switch which energizes the anodes of the rectifier tubes.

A further purpose appears in the specification and in the claims.

In the drawing I have chosen to illustrate only one of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

The drawing shows on electric circuit diagram useful in explaining the invention.

In the prior art so-called electrical knives and cauteries have been produced, which have been used with varying degrees of success in surgery, such as brain surgery and prostatic surgery. It was used in these operations largely for hemostatic purposes, and there was a substantial amount of tissue destruction and necrosis incidental to the use of the device. The present inventor has

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endeavored to minimize necrosis and tissue destruction so as to make an electronic cautery which can be used in all types of surgery and not merely those in which hemostatic action is desired. Thus, by the equipment of the present invention it is possible to remove sections of tissue for biopsy and to secure representative samples of tissue sections which will indicate the condition of the body from which the sample is taken.

The electronic cautery of the present invention is an improved device which is designed to enable the surgeon to make any desired incision without exerting pressure which deforms the tissue, and with assurance that the incision will heal normally and without any untoward incidents due to the presence of the electric discharge. Great care has been used in the development of the present mechanism to operate at a frequency which is most conducive to benign surgery, and to secure most effective blocking to cut off stray currents and limit normal currents to safe limits. On the other hand the device of the invention can be adjusted to give hemostatic effects if desired.

In accordance with the invention, a uni-directional current is obtained from a full-wave rectifier, and the output of the full wave rectifier is converted by a transmitter tube fitted to a tank circuit to create a frequency of from 2.75 to 3.25 megacycles. Blocking is introduced between the transmitter tube and the tank circuit. The inductive element of the tank circuit discharges to electrode terminals at one end through blocking capacitors and to a dispersive contact at the other end through a blocking capacitor. One of the electrode terminals is provided with additional blocking capacitance and both are preferably provided with variable blocking capacitance.

The mechanism is arranged so that the cathodes of all of the vacuum tubes can be energized in advance, and the final operation of the electronic cautery is produced by energizing the anodes of the rectifier tubes.

Considering now the drawing in detail, the circuit comprises a rectifier 20, a transmitter tube 21 and a tank circuit loop 22, to be more fully described in detail.

A source of alternating current suitably at commercial frequency, desirably 110 volts at 60 cycles, is connected to input terminals 23 and 24. These terminals connect through a pre-action switch 25 to the primary of a rectifier filament transformer 26 and to the primary of the transmitter tube filament transformer 27. The secondary of the transformer 26 is connected to the cathode of half-wave gas-filled rectifier tubes 28 and 30, whose cathodes are opposed as well-known. A mid-tap 31 from the secondary of the transformer 26 is connected to one side of the anode choke 32, the other side of which is connected to the anode of the transmitter tube 21, and is also connected through anode biasing resistor 33 in parallel with capacitor 34 to ground, to reduce ripple.

The secondary of the transmitter tube filament transformer 27 is connected to the cathode of the transmitter tube 21, and the mid-tap 35 is grounded, and capacitors 36 and 37 are connected between the opposite terminals of the secondary of the transformer 27 and ground to eliminate ripple.

The terminals 23 and 24 are also connected to the primary of the anode transformer 38 through normally open relay 39 whose heater coil 39' is across the secondary of the transformer 27 and the secondary of this transformer is connected to the anodes of the half wave rectifier tubes 28 and 30, mid-tap 40 being grounded. Relay 39 is a thermal time delay relay which assures that the cathodes of rectifier tubes 28 and 30 are heated be-

fore voltage is applied to the anodes, thus assuring damage will not be done to the tubes or other circuit components.

The output of the rectifier is connected through the choke 32 to the anode of the transmitter tube as already explained. The control grid of the transmitter tube is grounded through choke 41 and grid biasing resistor 42, so that energy passes to the grid through ground. The anode of the transmitter tube 21 is connected through auxiliary blocking capacitor 43 to one side of the tank circuit loop 22, which includes a capacitor 44 and an inductor 45 in parallel resonance. The control grid of the transmitter tube is connected through auxiliary blocking capacitor 46 to the opposite side of the tank circuit loop 22.

The output from the electronic cautery is taken off from one side of the inductive reactance 45 through a lead 46' which passes to an electrode terminal 47 and an electrode terminal 48 in parallel. The lead 46' is connected to the inductive reactance near the end connected to the anode (plate) of tube 21, and by adjusting the tap closer to the end of the reactance connected to the anode, the severity of the cautery can be increased. Both of the electrode terminals 47 and 48 are equipped to receive an electronic cautery implement as well-known in the art and which will vary in shape depending upon the character of the incision being made. In some cases it may be a needle, in others a knife, or a wire loop. Between both of the electrode terminals 47 and 48 and the inductive reactance 45 is placed a so-called link (blocking) capacitor 50 and a main blocking capacitor 51. In the branch individual to the electrode terminal 48, a complementary blocking capacitor 52 is included in the circuit.

The opposite side of the inductive reactance 45 is connected preferably at the center by a lead 53 to ground and through a main blocking capacitor 54 to a dispersive electrode 55 of the character well known to the art which makes ground connections to the patient and may be a plate conductive blanket or other large area conductor.

In operation the equipment is turned on, prior to use, by energizing pre-action switch 25. It is, however, in safe condition and cannot cause an incision or accident to the operator until the operator turns on a final-action switch 56 which is in series with the primary of transformer 38.

The operator now adjusts the energy of discharge by manipulating a link capacitor 50. By this means the energy available at the cautery implement may be varied between a very small and a very large energy limit depending upon the character of surgery being done.

Terminal 48 would be used where hemostatic action is desired, due to the fact that there is a heavier discharge.

The preferred dimensions for the various components referred to herein are as follows, although these dimensions may be varied within the principles of the invention.

Transformer 26 is a step-down transformer with a primary voltage of 110 volts at 60 cycles and a secondary voltage of 2.5 volts at 60 cycles.

Transformer 27 is a similar step-down transformer with a primary voltage of 110 volts at 60 cycles and a secondary voltage of 6.5 volts at 60 cycles.

Transformer 38 is a step-up transformer with a primary voltage of 110 volts at 60 cycles and a secondary voltage of 900 volts at 60 cycles.

Rectifier tubes 28 and 30 are preferably of type 866 Junior.

Capacitors 36 and 37 are of 0.002 microfarads 600 volts working capacity.

Transmitter tube 21 is preferably of type 812A.

Choke coil 32 has a reactance of 2.5 millihenries and has a working capacity of 300 milliamperes.

Capacitor 34 is of one microfarad capacity at 2500 volts working capacity.

Resistor 33 has a resistance of 40,000 ohms with a rated capacity of 50 watts.

Choke coil 41 has a reactance of 1 millihenry with a working capacity of 300 milliamperes.

Resistor 42 has a resistance of 4,000 ohms with a working capacity of 50 amperes.

Capacitor 43 has a capacity of 0.002 microfarads at 2,500 volts working capacity.

Capacitor 46 has a capacity of 0.001 microfarads at 2,500 volts working capacity.

Inductance 45 has a reactance of 24.1 millihenries.

Capacitor 44 has a capacity of 0.000018 micro-microfarads which withstands a short circuit test at 5000 volts.

Variable capacitor 50 has a range from 9 to 38 micro-microfarads which withstands a short circuit test under 5000 volts.

Blocking capacitor 51 has a capacity of 0.002 microfarads at a working capacity of 2,500 volts.

Blocking capacitor 52 has a capacity of 0.004 microfarads at a working capacity of 2,500 volts.

Capacitor 54 has a capacity of 0.001 microfarads at a working capacity of 2,500 volts.

It will be understood, of course, that these dimensions can be changed to give a device which will have modified character as desired by the user for a particular character of service.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claim.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

In a device for making an incision in live tissue without shock and without damage to tissue which will prevent normal healing, a full wave rectifier, circuit means connecting the full wave rectifier to a source of alternating current at normal frequency, a power vacuum tube connected to the output side of the full wave rectifier, a tank circuit having a capacitative reactance and an inductive reactance connected to the output side of the power vacuum tube and connected to be in resonance, auxiliary blocking condensers between the tank circuit at each side and the power vacuum tube, an electrode terminal connected to the inductive reactance, and adapted to receive an incision electrode, a dispersive electrode connected to a spaced point on the inductive reactance, and blocking capacitative reactance in series between the inductive reactance and the electrode terminal and between the inductive reactance and the dispersive electrode, and a variable capacitative reactance between the inductive reactance and the electrode terminal.

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